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Beyond recipes: The Baconian natural and experimental histories as an epistemic genre

Cesare Pastorino

Technische Universität Berlin, Berlin, Germany

Correspondence
Cesare Pastorino, Technische Universität Berlin, Berlin, Germany.
Email: cesare.pastorino@gmail.com

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SPECIAL ISSUE
The Creative Power of Experimentation: Bacon and Della Porta

GUEST EDITORS
Doina-Cristina Rusu and Dana Jalobeanu

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Abstract

In 1622, Francis Bacon published his *Historia naturalis et experimentalis*. Many of the features of Bacon's natural and experimental histories were entirely new. This paper studies this literary form as a new epistemic genre. In particular, it analyzes its origin and evolution in Bacon's work, focusing on how its basic template and features were influenced by his specific epistemic requirements. It shows that Bacon devised these features in the process of developing a *Historia mechanica*, or a history of the mechanical arts, drawing on the particular case of the technical recipe. Since antiquity, the recipe had been the dominant epistemic genre for recording and communicating technical knowledge. However, this paper suggests that the recipe format did not meet Francis Bacon's epistemic needs. In particular, the format was incompatible with the goal of keeping experimentation and its reporting open-ended and flexible. More generally, the acknowledgment of the provisional, historical character of knowledge was a tenet of what Bacon called an "initiative" method of knowledge transmission, or a method of "probation." According to this approach, knowledge "ought to be delivered and intimated, if it were possible, in the same method wherein it was invented" and discovered. Only the display of its tentative features would encourage and stimulate others to improve and advance it. The format of the new genre of natural and experimental

histories grew out of Bacon's dissatisfaction with the way in which recipes hid the imperfection of the process of knowledge production.

KEYWORDS
books of secrets, epistemic genres, error, experiment, Francis Bacon, recipes

1 | INTRODUCTION

In 1622, Francis Bacon published a work the title of which, *Historia naturalis et experimentalis*, would have sounded unusual to many readers. Of course, early 17th-century audiences would not have been caught unawares by a reference to "natural history." Renaissance scholars were very well acquainted with Pliny the Elder's *Natural History*, a classic text that saw many editions and commentaries in Latin and vernacular during the 15th and 16th centuries.[1] Additionally, a more specialized readership of those who investigated nature would have been familiar with works by the new generation of Renaissance natural historians, who have been described by Brian Ogilvie in his *Science of Describing*.[2] However, Bacon's reference to a "*Historia experimentalis*" would have been perplexing to many; this was a new term and concept, entirely Bacon's coinage.[3] As Dana Jalobeanu has aptly commented, the project for a *Historia naturalis et experimentalis* was "new wine in old bottles": it reassured readers, referring to a long and established tradition of *Historiae*, but also disconcerted them, pointing to "new ideas, new practices and new modes of collaborative research."[4]

This paper will concentrate on the novel features of Bacon's natural and experimental histories. I claim that these characteristics gave rise to a new literary form—in fact, a new epistemic genre, in the sense recently developed by Gianna Pomata.[5] Other authors—especially Graham Rees, Paula Findlen, Brian Ogilvie, and Dana Jalobeanu—have emphasized the new character of the Baconian histories.[6] However, in this paper, my focus is on the precise determination of the origin and evolution of this genre in Bacon's work, and on how its template and features were influenced by Bacon's specific epistemic requirements. I show that Bacon devised it in the process of developing a *Historia mechanica*, or a history of the mechanical arts. Working on this project, Bacon conceived a particular template for describing technical inventions or "experiments of the mechanical arts." Bacon employed the same format more generally to describe experimentation in his new natural and experimental histories.

Bacon developed the template in his *Historia mechanica* by drawing on the example of technical recipes. Dating from antiquity, the recipe had been the dominant epistemic genre for recording and communicating technical knowledge. In the Renaissance, printed collections of recipes achieved enormous popularity in the tradition of "books of secrets," as for instance exemplified by Giovan Battista Della Porta's best-selling *Magia Naturalis*.[7] However, I

[1]On the fortune of Pliny in the Renaissance, see Nauert (1980).
[2]In that text, Brian Ogilvie suggests that "natural history was invented in the Renaissance." Ogilvie refers to natural history as a discipline and method, not as a literary genre. Of course, the genre "had distinguished roots in classical antiquity and the Latin Middle Ages, and a namesake in the Roman encyclopedist Pliny the Elder's *Natural History* (*Naturalis historia*)." However, according to Ogilvie, 16th-century naturalists transformed it into a "field of inquiry with accepted principles," a discipline that established description as its "central concern"—natural history as a "science of describing." Ogilvie (2006, pp. 1, 5–6).
[3]At least to this author's knowledge. Before, this expression only appeared in print in Bacon's appendix to the *Instauratio magna* (1620), the *Parasceve ad historiam naturalem et experimentalem*. A first explicit reference to an "experimental history" can be found in Bacon's unpublished *Descriptio globi intellectualis* of 1612: Bacon (1996, p. 102).
[4]Jalobeanu (2015, p. 9).
[5]According to Pomata (2013, p. 133), epistemic genres are a "class of genres which develop in tandem with scientific practices, broadly meant."
[6]See Rees's Introduction to Bacon (2007, pp. xix–xxxiii, "Natural History and the End of Erudition") ; Findlen (1997); Ogilvie (2006); Jalobeanu (2015). See also Pastorino (2011).
[7]Della Porta (1558; 2nd ed., 1588).

suggest that the recipe format, while clearly very familiar to Francis Bacon, did not meet his epistemic requirements. In particular, Bacon stressed the necessity of keeping experimentation and its reporting open-ended and flexible. This new attitude implied a change in the epistemic value of "failure" and error in experimental practice. Books of secrets tended to represent their authors as experts and authorities. Their implicit assumption was that the recipes within were flawless and complete. In contrast, Bacon's experimental reports were provided as temporary and perfectible. This acknowledgment of the provisional, historical character of knowledge was a tenet of what Bacon called an "initiative" method of knowledge transmission, or a method of "probation." According to this approach, Bacon stated, knowledge "ought to be delivered and intimated, if it were possible, in the same method wherein it was invented" and discovered. Only the display of its tentative features would encourage and stimulate others to improve and advance it. The format of the new genre of natural and experimental histories grew out of Bacon's dissatisfaction with the way in which recipes hid the imperfection of the processes of knowledge production.

2 | FROM THE *HISTORIA MECHANICA* TO THE NATURAL AND EXPERIMENTAL HISTORIES

The development of the new genre of the natural and experimental histories intertwined with Bacon's early, pivotal project for the establishment of a "history" of the mechanical arts. The importance of this project has not been sufficiently emphasized in the literature. Already in 1605, at the time that *The Advancement of Learning* was published, Bacon had clearly delineated its aims and characteristics. For Bacon, the composition of a "Historie Mechanical" (also indicated as a *Historia Mechanica*) was:

> of all others the most radicall, and fundamentall towardes Naturall Philosophie, such Naturall Philosophie, as shall not vanish in the fume of subtile, sublime, or delectable speculation, but such as shall bee operatiue to the endowment, and benefit of Mans life.[8]

By this history, Bacon clearly meant a description of extant "experiments," or inventions, of the crafts. This history would:

> not onely minister and suggest for the present, Many ingenious practizes in all trades, by a connexion and transferring of the obseruations of one Arte, to the vse of another, when the experiences of seuerall misteries shall fall vnder the consideration of one mans minde: But furder, it will giue a more true, and reall illumination concerning Causes and Axiomes, then is hetherto attained.[9]

It is important to remember that, conceptually and terminologically, Baconian "experiments" and "*experimenta*" did not only refer to the activity of the sciences, but also included technical inventions of the mechanical arts. So, for instance, while introducing the *Historia Mechanica* in *The Advancement of Learning*, Bacon suggested that extant accounts of the mechanical arts were defective exactly because of their "reiection of experiments familiar and vulgar."[10]

What was the precise literary form that the "Historie Mechanical" was supposed to assume? Two sources help to answer this question: the unpublished and unfinished treatise *Valerius Terminus*, likely composed, revised, and

[8] *The Advancement of Learning*, Bacon (2000a, pp. 64–65).

[9] *The Advancement of Learning*, Bacon (2000a, pp. 64–65). As the references to "connexion" and "transferring" of observations indicate, this passage of *The Advancement of Learning* also related to what was likely the first embryonic description of an important Baconian notion, *experientia literata*. This is the idea that new experiments (in this case, new technical inventions) could be "translated" and transferred from previous ones, bringing together and merging knowledge from different trades and contexts. See Pastorino (2017) for a discussion of the origins of *experientia literata* in Bacon's work.

[10] On this issue, see Pérez-Ramos (1988, p. 149); Pastorino (2017, p. 754).

finally abandoned between 1603 and the time of the preparation of *The Advancement of Learning*; and the observations and notes present in the *Commentarius solutus*, a private memorandum composed by Bacon in the summer of 1608.

In *Valerius Terminus*, Bacon described plans for the preparation of a "Kalendar or Inventory of the wealth, furniture, or means of man according to its present estate." As a section title explained, the "Inventory" was an "enumeration and view of inventions already discovered and in use, together with a note of the wants and the nature of the supplies." Bacon had in mind a list of "sciences, arts, inventions, works … according to the use and tribute which they yield and render to the conditions of man's life."[11] It is then quite clear that the "Kalendar" of *Valerius Terminus* had a strongly operative and utilitarian character.

The operative character of the Inventory was also evident in a passage of *The Advancement of Learning*, where the "Calendar"—called in the margin an "*Inventarium Opum humanarum*"—was considered preparatory ("by way of preparation") to Natural Magic and knowledge of forms. However, in *The Advancement*, "inventions" included the "works or fruits of Nature or Art," and a preference for non-utilitarian experiments "giving the most light to the Invention of causes" started to emerge.[12] The range of inventions and experiments to be included in a proper *Inventarium* then started to acquire the shape of the range of topics that Bacon will subsequently require for his natural and experimental histories. While the Kalendar and the "Historie Mechanical" certainly show distinct phases of Bacon's reflection, they were most likely embryonic forms of the same project.[13]

The private memorandum *Commentarius solutus* of 1608 more explicitly described the precise compositional style of the *Historia mechanica*. In particular, Bacon annotated the sketch of a template for describing the experiments of the mechanical arts that would fill the history:

> To procure an History mechanique to be compiled with care and diligence and to professe it that is of the experim^{ts} and observations of all Mechanicall Arts. The places or thinges to be inquyred are; first the materialls, and their quantities and proportions; Next the Instrum^{ts} and Engins requesite; then the use and adoperation of every Instrum^{t}; then the woork it self and all the processe thereof wth the tymes and seasons of doing every part thereof. Then the Errors w^{ch} may be comytted, and agayn those things w^{ch} conduce to make the woorke in more perfection. Then all observacions, Axiomes, directions. Lastly all things collaterall incid^{t} or intervenient.[14]

This statement is crucial, as the scheme for the "History mechanique" from the *Commentarius* would act as the template Bacon would subsequently use to craft the structure and form of his natural and experimental histories more generally. His first full attempt at producing a "specimen single-subject history" was the *Phænomena universi* of 1610–1611. It was arranged "as a series of collections of data (*historiae*), each of which was followed by appropriate admonitions (*monita*) and then (occasionally) reflections on causes (*observationes*)."[15] The introduction of admonitions and observations, or detailed accounts of experiments, after the proper *historiae* followed the scheme described in the *Commentarius*. In the coeval *De fluxu et refluxu maris* (1611), one can also find *Mandata*, or directions and "assignments" for future inquiries.[16] The *Parasceve ad historiam naturalem et experimentalem*, a text included in the *Instauratio magna* of 1620, did not deviate from this scheme. Among the "extra useful features" of the new natural histories, it described the *Quaestiones*, analogous to the *mandata*, and promoting and "[encouraging] further investigation"; the *Modus experimenti*, comparable to the *historiae*; the *Notae* and *Monita*, already introduced in the *Phænomena universi*; and, again, *Observationes*.[17]

[11]Bacon (1857–1874, Vol. 3, pp. 233, 234).
[12]Bacon (2000a, p. 90).
[13]On the connection between the "Inventory" of *Valerius Terminus* and the "Inventarium" of the *The Advancement of Learning*, see also James Spedding's preface to *Valerius Terminus*: Bacon (1857–1874, Vol. 3, pp. 210–211).
[14]Bacon (1857–1874, Vol. 11, pp. 65–66).
[15]See Rees's Introduction to Bacon (1996, pp. xxv–xxviii).
[16]Bacon (1996, pp. 88–91).
[17]Bacon (2004, pp. 468–471).

Finally, the *Historia naturalis et experimentalis* of 1622 formalized Bacon's template from the *Commentarius*. In this work, he again employed the various practices he had already described in his text of 1608. In the prefatory section, titled *Norma Historiæ praesentis*, he again highlighted the paramount role of *Historiae* and experimental accounts. In accordance with the suggestions in the *Commentarius*, Bacon stated that the histories needed to report "advice and cautions about the fallacies of things, and the errors and snags which may crop up in the course of inquiring and discovering," and also incorporate personal interpretations, speculations, provisional rules, and theoretical conclusions.[18]

In conclusion, the new epistemic genre that Bacon formally publicized and established in 1622, the *Historia naturalis et experimentalis*, grew in a process that had developed during the previous two decades, and had its origins in Bacon's initial project for a *Historia mechanica*, an account of all the useful experiments and inventions derived from the mechanical arts. In particular, the template and scheme that Bacon had already developed in 1608 while attempting to build his *Historia mechanica* was subsequently employed more generally for his natural and experimental histories. This template was initially aimed at describing the technical experiments and industrial processes of the mechanical arts. It is therefore not surprising that this model retained prominent stylistic features that belonged to a previous, different epistemic genre and format that had been employed to describe technical processes, that is, the recipe. However, Bacon had already, in the discussion in the *Commentarius* of 1608, introduced substantial modifications to that format. The next section will discuss this aspect in full, mainly focusing on the ways in which Bacon modified the simpler recipe format and moved toward open-ended, provisional descriptions of experimental processes.

3 | FROM RECIPES TO OPEN-ENDED ACCOUNTS

As mentioned, the scheme that Francis Bacon developed in the *Commentarius* derived its form from the structure of a previous, fundamental, epistemic genre, the recipe. As Gianna Pomata has reminded us, this genre had an "extraordinary longevity, spanning millennia of history, from remote antiquity to the modern period, while also exhibiting an astonishing stability of structure."[19] Recipes were, of course, the traditional medium for the transmission of medical and pharmaceutical knowledge; however, from antiquity, the recipe format was also largely employed to codify and transmit technical know-how.[20] The early modern period saw no decline in the popularity of this format, and recipes were eagerly collected and collated in manuscript form in households, workshops, markets, and courts. Also, with the advent of print, collections of medical, alchemical, and technical recipes were published in the new and widely popular genre of books of secrets.[21] As Arianna Borrelli explains in a different article of this issue, one of the most eminent "Professors of Secrets," Giovanni Battista Della Porta, made extensive use of the recipe format and adopted it in unexpected contexts, such as optics, as an intellectual tool for the production of new knowledge.[22] Della Porta's major work, the *Magia naturalis*, was widely published, translated, and read all over Europe, well into the 17th century.[23] Francis Bacon was one of its most careful readers and included many of Della Porta's secrets in his *Sylva sylvarum*. Given this general background, it is then not surprising that Francis Bacon paid close attention to the genre

[18]Bacon (2007, pp. 13–17).

[19]Pomata (2013, p. 136). In her analysis of medical recipes, Pomata distinguishes between "recipe" and "formula." According to her, "the formula contains the established, standard way of preparing a medication, as prescribed by an authoritative text." In contrast, the recipe is "a *prescription* for an actual patient: it contains the record of a practitioner's case centered on the description of the medication that he prescribed." Pomata rightly suggests that recipes and formulas should not be confused: "they have very distinctive features: the formula tends to be theoretical and universal, whereas the recipe tends to be individualized and practical. In other words, the formula belongs to the realm of rules, the recipe to the register of facts" (Pomata, 2013, p. 139). If this distinction is crucial in the case of medical recipes, it does not seem to be so for technical recipes. For this reason, in my discussion I will generically use the term "recipe."

[20]Eamon (1994); Long (2004); Leong & Rankin (2011); Smith (2011); Pomata (2013).

[21]Eamon (1994); Leong & Rankin (2011).

[22]See Borrelli (2020).

[23]Della Porta (1558; 2nd ed., 1588).

of recipes, and that the template of the "History mechanique" in the *Commentarius* included crucial elements from their format.

The well-known case of medical recipes can be employed to summarize their generic structure as a "list of ingredients plus instructions for preparing and administering their compound."[24] Technical recipes presented a similar arrangement: they included "ingredients" in the form of materials and devices employed in a particular technical process, where the precise account of the various technical operations corresponded to the description of the "instructions" of the recipe.

Bacon's template in the *Commentarius* included both elements. Let us consider again the initial part of his description:

> The places or thinges to be inquyred are; first the materialls, and their quantities and proportions; Next the Instrumts and Engins requesite; then the use and adoperation of every Instrumt; then the woork it self and all the processe thereof wth the tymes and seasons of doing every part thereof.[25]

Bacon's text insisted on the precise specification of the materials and instruments involved in a particular technical process, or the "ingredients" of the technical recipe. It also stressed the necessity of describing the "instructions" of the recipe—the use of materials and instruments, and the processes and operations of a particular technical procedure (with indication of appropriate "tymes and seasons").

These elements of the template did not differ much from the ones we can find in books of secrets, or in pre- and early modern technical texts that made use of the recipe form. For example, two very famous technical treatises of the 16th century, the *Pirotechnia* of Vannoccio Biringuccio and *De re metallica* of Georg Agricola, frequently employed the recipe format—including its stylistic element of rendering the verb in the imperative mood. For instance, Biringuccio's lengthy description of the process for refining saltpeter with water in Book 10 of *Pirotechnia* consisted of a long list of instructions about materials and their quantities, instruments, and procedures:

> [D]o it in one of two ways that I shall now teach you …. With water, it is refined in this way. Take some of the aforesaid magistery made of lime, ashes, and dissolved alum, and for every barrel of water that you have put in the kettle for dissolving the saltpeter put in four to six jugfuls of this lye or of aqua fortis. Put as much saltpeter into this quantity of prepared water as it seems to carry in order to liquefy well. Then cause it to dissolve well by boiling it. When it has raised a foam in boiling, take it out of the kettle and put it in a vat in the bottom of which you have first put four *dita* of well-washed coarse river sand covered over with a little piece of cloth.

In the rest of the recipe, Biringuccio gave details of several other required passages and operations. At the end of all these procedures, Biringuccio stated, "you will have your saltpeter very white and beautiful and much better than in the first cooking."[26]

Georg Agricola, an author whom Bacon held in high regard, often used the recipe format, too. For instance, the precise descriptions of ore assaying in Book 7 of *De re metallica* took the form of technical recipes. At the beginning of the book, Agricola stressed that he intended to produce descriptions of "methods of assaying ores," and he wanted to "explain all these methods with the utmost care."[27] In the rest of the book, Agricola produced systematic and detailed descriptions of technical processes of assaying, in which particular preparations or procedures were described in an orderly fashion, as in a textbook. Not dissimilarly from the case of Biringuccio, the tone of Agricola's prose was pedagogic and instructional. As such, it included many instances of procedural directions and instructions;

[24]Pomata (2013, p. 137).
[25]Bacon (1857–1874, Vol. 11, pp. 65–66).
[26]Biringuccio (1943, p. 408).
[27]Agricola (1950, p. 219).

in other words, many technical recipes. For example, when dealing with gold ores not easily melted by fire, Agricola instructed:

> Mix one part of this ore, when it had been roasted, crushed, and washed, with three parts of some powder compound which melts ore, and six parts of lead. Put the charge into the triangular crucible, place it in the iron hoop to which the double bellows reaches, and heat first in a slow fire, and afterward gradually in a fierce fire, till it melts and flows like water.[28]

So, the first part of the template that Bacon devised in the *Commentarius*—detailing the materials to be used, together with their "quantities and proportions," the instruments involved, and the particular technical processes to be employed—reproduced a format that was commonly employed by authors of technical texts, like in the previous examples.

However, the final part of the template for the "History mechanique" of the *Commentarius* made a sharp departure from the recipe style:

> Then the Errors wch may be comytted, and agayn those things wch conduce to make the woorke in more perfection. Then all observacions, Axiomes, directions. Lastly all things collaterall incidt or intervenient.[29]

In Bacon's view, "Errors wch may be comytted" fully belonged to his history of experiments in the mechanical arts. Also, entries should have included descriptions of ways to improve work, plus all observations, conclusions, or further suggestions deemed relevant. As shown in the previous section, all these new elements were preserved and expanded in the *Phænomena universi* (1610–1611), the *De fluxu et refluxu maris* (1611), and the *Parasceve ad historiam naturalem et experimentalem* (1620)—the series of texts that finally led to the formalization of the *Historia naturalis et experimentalis*. An opening passage in *Phaenomena universi* provides a good explanation of Bacon's intentions and motivations and is worth quoting in full:

> But since I have set out not to conjecture or prophesy, but to discover and know, since I judge that this is heavily dependant on the examination and trial [*examine* and *probatione*] of basic experiments, I am quite decided in the case of every more subtle experiment to say clearly how I went about it, so that when my decisions in single cases have been disclosed, men may see both how far to believe in them, and what more has to be done either to correct any mistakes in them or to provoke and carry out more trustworthy and precise trials [*probationes magis fidas* and *exquisitas*]. Furthermore, I shall myself warn sincerely and faithfully of things which shall appear to me to be less certain and more open to error, and as it were on the borderline.[30]

Altogether, the new features that Bacon had in mind broke the closed structure of the recipe format. In particular, their goal was that of promoting "the examination and trial" of experiments themselves. "More subtle" experiments needed to be accounted for with special accuracy. However, the aim of these accounts was to put experiments to the test (*probatio*); "men may see … how far to believe in them," and also try to find "what more has to be done." Experiments should not be taken at face value; the goal of the experimenter is to evaluate accounts to "correct any mistakes in them," or, if they seem acceptable, to further conduct, "provoke[,] and carry out more trustworthy and precise trials [*probationes*]" on them.

In conclusion, Bacon's experimental accounts were not descriptions of exemplary and established procedures. Instead, Bacon envisaged reports that were tentative, open-ended, and subject to modification. Notably, these

[28]Agricola (1950, p. 243).
[29]Bacon (1857–1874, Vol. 11, pp. 65–66).
[30]Bacon (1996, pp. 13–15).

accounts did not hide "things which shall appear … to be less certain and more open to error." Instead, Bacon's descriptions sought to give prominence to mistakes and errors that occurred in experimentation; following Bacon's intentions, these parts of experimental practice achieved an important epistemological status.

4 | SECRETS, AUTHORITY, AND ERRORS

Bacon's attitude toward errors and mistakes in experimental practice marks a strong departure from their role in books of secrets. Errors and their acknowledgment had little currency in these texts. The authority of professors of secrets was established in a marketplace of knowledge that emphasized the value and importance of successful results and effective expertise.

As William Eamon has stressed, a significant concern for professors of secrets was to establish their authority as experts in a highly competitive social environment. In the case of medical secrets, their books were a way to promote drugs in a "changing medical marketplace," filled with a "multitude of medical empirics and charlatans."[31] According to Eamon, books of secrets were produced to gain "a competitive advantage." They were addressed to buyers of secrets, but also to "patrons and potential patrons: that is to say, they aimed to show potential patrons that one had something useful to offer." By its inclusion in a printed book, Eamon suggests, a secret would gain "a kind of certification of its efficacy." In this way, "rather than serving as guides to experimentation … books of secrets were meant to demonstrate the authority and expertise of the author."[32]

The necessity to establish and demonstrate one's expertise inevitably implied an obliteration of any discussion of errors and failure; secrets were expected to be successful. A contemporary source, Tommaso Garzoni, described how proper secrets should look. In his *Piazza universale*, Garzoni stated that "secrets are the more valuable, the more they are perfect and nice, and quickly produced and with easiness." In a different passage Garzoni further delineated "the features of good secrets": they "should not be untrue; should be useful, highly profitable; not against one's conscience; and easy to be sold; not requiring a long wait; or producing unbearable exhaustion; and finally, dealing with things worthy of an honorable man."[33] In his statements, Garzoni echoed the *De secretis* of Girolamo Cardano, according to whom "perfect" secrets are those that "always achieve their result."[34]

A consequence of this approach was that the authors of books of secrets tended to establish rhetorically their recipes as canonical. As Eamon has pointed out, they did not intend "their works to be read as experimental books in the usual sense: that is, they did not expect, nor did they instruct, readers to experiment with the recipes or even to deviate from them in any way." Recipes came as "tried out," already "certified by experiment." In general, authors of books of secrets "did not encourage readers to experiment independently, only to follow the instructions exactly as written …. Thus, instead of being prescriptions to experiment, as they are sometimes taken to be, the books of secrets provide rules to follow."[35] Eamon gives the example of an important author, Isabella Cortese, who recommended to her readers that they should "just follow the rules that I have written down for you… do not increase or diminish anything, but do what I say and write, and follow my commandments."[36]

[31]Eamon (1994, pp. 134-139; quotations on p. 138).

[32]Eamon (2011, pp. 30, 31, 33). Professors of secrets did not differ much from the early modern alchemists in their constant struggles to establish their authority, as described by Tara Nummedal (2007). On the issue of authoritativeness in books of secrets ascribed to ancient authorities and sources, see, for instance, the work of Allison Kavey (2007).

[33]"Queste poi sono le conditioni de" buoni secreti; che non sian fallaci; che arrechino utile e guadagno grande; che non nuocano alla conscienza; che sian cose facilmente vendibili; che non sian di longhissima aspettazione; che non v'intervenga fatica intolerabile; & finalmente che versino attorno a cose degne di huomo nobile." Garzoni (1585, pp. 184–185).

[34]Cardano (1663, Vol 1), especially Ch. 22: "De utili secreto, quot conditiones habere debeat" (p. 549); "secreta quaedam perfecta, quae semper effectum consecuuntur." (p. 538).

[35]Eamon (2011, pp. 29–30).

[36]Eamon (2011, pp. 164). "segui quello che ti scrivo, e non levare ne scemare cosa alcuna, ma farai quel che dico e scrivo, e segui gli infrascritti commandamenti miei." Cortese (1565, p. 20).

Recipes could, of course, be wrong, even though rhetorically presented as definitive and flawless by their authors. Moreover, recipes themselves were not fixed knowledge, as their readers often tested and modified them.[37] However, both in collections of secrets and more widely, the recipe format lacked what Sven Dupré has very aptly called the "codification of error," that is, the notion that in writing about practical knowledge, "rather than writing down how to proceed, authors write down what not to do."[38] Because of this fact, according to Dupré:

> Recipes changed but this was often unnoticed. The standard was silent change. Authors of recipes corrected a recipe, sometimes because workshop practice demanded such, but they did not note that they had corrected their source recipe, or how exactly the source recipe was lacking. Moreover, authors of recipes seemed more interested in collecting various ways to arrive at the same or a similar result, than in sorting out the right ways from the wrong.[39]

Then, discussion of errors belonged outside the body of the recipe, to its physical margins in manuscripts and books, where readers annotated their evaluations and observations. Only from the early modern period did "evaluative notes [move] from the margin of the text to the body of the text … this is termed 'the codification of error.' In this way writing down artisanal experience begins to reflect reading."[40]

In his natural and experimental histories, Francis Bacon introduced strategies for the codification of error that were missing in books of secrets. A fundamental factor that allowed this new approach was a different attitude toward the establishment of trust and authority. Natural magicians, Bacon stated in the *Novum organum* in a comment that could easily be intended for authors of secrets, "falsely ascribe by idle and inert speculations wondrous virtues and operations to things; and when they show off their Wares, these latter are of a kind suited to admiration and novelty and not to fruitfulness and utility."[41] Later on, in a passage of the *New Atlantis*, Bacon reinforced the same notion:

> And surely you will easily believe that we that have so many things truly natural which induce admiration, could in a world of particulars deceive the senses, if we would disguise those things and labour to make them seem more miraculous. But we do hate all impostures and lies: insomuch as we have severely forbidden it to all our fellows, under pain of ignominy and fines, that they do not shew any natural work or thing, adorned or swelling; but only pure as it is, and without all affectation of strangeness.[42]

The search for "admiration" and novelty was not worthy of a real philosophical experimenter, and more suitable for the marketplace. In fact, the institutions for the advancement of learning that Bacon conceived over time tended to remove experimenters and inventors from the public spaces in which those qualities would have been necessary and requested. In the new spaces of knowledge that Bacon envisioned, secrets no longer needed to be marvelous or theatrical. As William Rawley, Bacon's literary executor, put it in his address to the readers of the *Sylva Sylvarum*, "his lordship's course is to make wonders plain, and not plain things wonders."[43] A collection of recipes and experiments like the *Sylva Sylvarum* was offered to its readers in the form of a book of secrets stripped of their marvelous and wondrous character—one could say, in the form of a book of secrets without any secret left. Bacon's experiments did not need to impress or produce admiration, but were only intended "*ad condendam Philosophiam*," for the

[37]See especially chapters 3 and 4 of Leong (2018).
[38]Dupré (2017, p. 170).
[39]Dupré (2017, p. 185). According to Dupré, the codification of error in artisanal recipes was mainly mediated by the transition from manuscript to print culture and the process of fixing and preserving of artisanal knowledge in written form.
[40]Dupré (2017, p. 171).
[41]Bacon (2004, p. 137).
[42]Bacon (2002, p. 486).
[43]Bacon (1857–1874, Vol. 2, p. 336).

"building up of Philosophy."[44] It was in this different philosophical context that issues of authority needed to be adjudicated. Errors could surface and move to the foreground, and their epistemic role could be recognized.

5 | BREAKING THE "CONTRACT OF ERROR": THE METHOD OF PROBATION

Together with tentativeness, open-endedness, and provisionality, errors became meaningful and legitimate components of Bacon's experimental accounts, not to be hidden and concealed in an attempt to provide flawless narratives. A similar attitude regarding the epistemic value of errors and open-endedness can be found more generally in Bacon's ideas about the proper methods for the transmission of knowledge. This section will show that an analysis of these methods can shed light on Bacon's choices regarding the best ways to communicate experimental knowledge and on his radical transformation of the traditional recipe genre.

Bacon discussed the transmission of knowledge in *The Advancement of Learning* (1605) and *De augmentis* (1621).[45] This is the subject of the "Method of Discourse," or the "art of Transmitting, or of producing and expressing to others those things which have been invented, judged, and laid up in the memory."[46] At the heart of his discussion was the sharp distinction between two main ways of communicating and teaching knowledge. Bacon stated that the "most real diversity of method [of transmissions] is [a] method referred to Use, and [a] method referred to Progression"; that is to say, between a way to teach what is already known and in use, and a way that instead favors "progression," or augmentation of knowledge. Bacon called the first method "magistral," while referring to the second one as to a method of "probation." (or the "initiative method," in *De augmentis*). The "magistral" method is a way to teach and transmit a body of already established knowledge. It can have some use, Bacon explained, for "compendious treatises for practice."[47] Its main shortcoming is that it hides the ways in which knowledge is achieved. In magistral reports, facts are presented to "be best believed," and not to "be best examined." A pact, or "contract of error," is established between deliverers and receivers, he stated. Deliverers hide their weaknesses, providing an apparently polished and perfected formulation of their knowledge; whereas the slothfulness of those who learn is prized, as they are implicitly invited not to doubt, question, or further inquire into what they are taught. Everyone prefers "rather not to doubt than not to err." For Bacon, this form of presentation hinders progress and the advancement of knowledge.[48]

The way to avoid this situation, Bacon asserted, is to break the "contract of error" between deliverer and receiver. To do so, he stated, knowledge "ought to be delivered and intimated, if it were possible, in the same method wherein it was invented" and discovered. Deliverers have to "revisit and descend unto the foundations" of their knowledge. "It is in knowledges as it is in plants": "carpenters" just want to use the body of the tree, and have no use for its roots; however, "planters" want their plant to grow after it has been removed, and care very much for the roots. "If you will have sciences grow, it is less matter for the shaft of body of the tree, so you look well to the taking up of roots."[49] Here, Bacon was possibly echoing a famous passage in Plato's *Phaedrus* where Socrates discusses the superiority of oral over written forms of transmission of knowledge. There, Plato compared the philosopher to a "sensible husbandman": philosophers will employ and prefer the dialectic method to written forms. Through it, they will be able to:

[44]The full characterization of Bacon's new histories was in fact a *Historia Naturalis et Experimentalis ad Condendam Philosophiam*. Bacon (2007, p. 2).
[45]See Book 6, Ch. 2 of *De augmentis*, in Bacon (1857–1874, Vol. 4). See also *The Advancement of Learning*, in Bacon (2000a, pp. 31, 122-124); for an earlier version, *Valerius Terminus*, in Bacon (1857–1874, Vol. 3, pp. 247–249). Lisa Jardine discussed Bacon's methods of knowledge transmission at length: Jardine (1974, Ch. 9, pp. 169-178).
[46]Bacon (1857–1874, Vol. 4, pp. 438–439), quoted in Jardine (1974, p. 169).
[47]Bacon (2000a, p. 31).
[48]Bacon (1857–1874, Vol. 4, pp. 403–404).
[49]Bacon (1857–1874, Vol. 4, p. 404).

> [plant] and [sow] in a fitting soul intelligent words which are able to help themselves and him who planted them, which are not fruitless, but yield seed from which there spring up in other minds other words capable of continuing the process for ever, and which make their possessor happy, to the farthest possible limit of human happiness.[50]

Both in Bacon and in Plato, knowledge is initially provided to the learner in a provisional state (its "roots" or "seed"), out of which it will develop and grow in new shapes, bringing a continuous "progression" and not coming to a halt. It is what Bacon called "knowledge broken," presented in an unfinished, fragmentary form and, because of this condition, "[inviting] men to enquire further."[51] Through this process, the initiative method, the learner is in fact transformed in an enquirer and "initiated" into a brotherhood of learning.[52] The relation between learner and imparter of knowledge does not follow that of a student and a teacher, but is instead modeled on the one between a father and a son: "the [son], as it were, of science."[53]

The initiative method has strong consequences if applied to the transmission and presentation of experimental practice. It implies that, for experimental knowledge to progress, we should not present it in its final, polished, and established form. Instead, our accounts should retain a tentative, heuristic, and imperfect character, and provide a sense of the process of experimental discovery. Bacon stylistically achieved this result by discarding the imperative mode of the recipe format in favor of first-person historical accounts of specific events.[54] For instance, when describing his trials on the expansion of substances in the *Historia densi et rari*, Bacon simply stated that

> I took a small glass phial capable of holding about an ounce. Into this I poured about half an ounce of spirit of wine …. Then I took a very large bladder, which as might be imagined was capable of holding eight wine pints …. As far as possible I squeezed all the air out of it …. In addition I smeared the bladder on the outside with a little oil and gently rubbed it in so as to block the bladder's pores with the oil.[55]

Also, in Bacon's experimental histories, errors and doubts about an experiment become as much a part of experimental accounts as established results and rules. In *The Advancement of Learning*, Bacon called the initiative method one of "probation." With this term, he referred to a proof, a trial, or a test.[56] Accordingly, what distinguishes knowledge imparted through the initiative method is its testability, its quality of being proved through a trial. In the case of experimentation, the method of probation implies that experimental knowledge should be presented and transmitted in the way that best allows one to test and experiment on it further. The type of "probations" that Bacon envisaged for his experiments confirms this conclusion. They are well represented in the passage from *Phaenomena universi* already discussed:

> But since I have set out not to conjecture or prophesy, but to discover and know, since I judge that this is heavily dependent on the examination and trial of basic experiments [*in examine & probatione experimentorum primorum*], I am quite decided in the case of every more subtle experiment to say clearly how I went about it, so that when my decisions in single cases have been disclosed, men may see both how far to believe in them, and what more has to be done either to correct any mistakes in

[50]Plato (1914, ss. 276e–277a). Vegetative metaphors of knowledge and knowledge transmission were widespread in antiquity and during the Renaissance; see especially Horowitz (1998).
[51]Bacon (2000a, p.124). See also Jalobeanu (2008, pp. 214–215). Bacon's reference is to aphorisms, but this attitude is more general.
[52]On the notion of brotherhood of learning in Bacon, see again Jalobeanu (2008).
[53]Bacon (1857–1874, Vol. 4, p. 449). In fact, an early Baconian text, the *Refutation of Philosophies*, depicted a congregation of such sons of science attending the teaching of an elder figure. However, in that text, the elder seems to employ a magistral, rather than initiative, approach in his teaching.
[54]As previously mentioned, these reports can be found in the *Historiae* in the narrower sense defined in the *Norma Historiæ praesentis*, that is, the specific parts of the experimental histories devoted to the narration of experiments: Bacon (2007, pp. 13–17). See Section 2 above.
[55]Bacon (2000b, pp. 67–69).
[56]So, for instance, a *Probatio* is defined as "A proofe, a tryall, an assay" in Thomas (1587/2006).

them or to provoke and carry out more trustworthy and precise trials [*probationes magis fidas & exquisitas*].[57]

As already mentioned, Bacon's goal was to test experiments themselves. The "examination and trial" of experiments already produced provide the basis for further experimentation, discovery, and a consequent advancement of knowledge. Bacon's experimental accounts are invitations to further trials and experimentation. This process of growth and proliferation of experimental practice is most evident in Bacon's posthumous work, *Sylva Sylvarum*, where the word "trial" and expressions like "trial would be made" and "trial may be made" are constantly reiterated throughout the text.[58]

6 | BEYOND RECIPES: RECIPES, TRIALS, AND OPEN TESTS

This essay has given major consideration to Francis Bacon's criticisms of the tradition of books of secrets. As previously noted, Bacon disliked their ostentatious character. In their works, professors of secrets ignored their errors and deficiencies to claim superior authority on technical procedures. Bacon's concern with books of secrets was certainly a product of their popularity and widespread appeal. Secrets were a printed genre, aimed at attracting the attention of an elite group of readers, and promising easy access to a wealth of extraordinary arts. Bacon's acknowledgment and codification of errors demarcated his differentiation from professors of secrets, and his claim for a superior, philosophical type of authority. Recognition of errors, plainness, and lack of ostentation helped to fashion the persona of the disinterested and virtuous experimental philosopher. In the process, secrets were stripped of their canonical status. In Bacon's natural and experimental histories, they were doubted, put to test, and often quickly discarded or used as a starting point for entirely new experimental undertakings.

When Bacon formalized his new genre, the testing of recipes and secrets was far from new, nor was it unique to him. In fact, Bacon belonged to a wide group of early modern experimenters who, between the 16th and early 17th centuries, increasingly put recipes to the test with different degrees of intensity and formality. For one thing, outside the domain of printed secrets, manuscript recipe books show the existence of a multitude of users who—in settings as diverse as households, workshops, and courts—exchanged, tested, and tweaked recipes, their ingredients, and their procedures.[59] In fact, there is good evidence showing that even Bacon himself participated in these social exchanges.[60] The testing and tweaking practices of these recipe collectors, however, were rarely emphasized. Instead, they were usually noted down in the margins or between the lines of individual recipes, or silently incorporated in old recipes, which were then recirculated in a new form.[61]

In some circumstances, the testing of recipes was given a more prominently visible place. For instance, among physicians and apothecaries, reports of drug and recipe testing became more and more common over the course of the 16th century.[62] Also, Giovan Battista Della Porta, himself a professor of secrets, described several recipe trials in his famous *Magia naturalis*. This book of secrets was anomalous, however, as it was not just a collection of procedures, but often included comments on recipes and these short accounts of recipe trials. As William Eamon has shown, the testing of recipes was actually a major goal of *Magia naturalis*: "by putting conventional techniques to the test of experiment, [Della Porta] hoped to find ways of improving existing techniques and to make new inventions."[63]. However, Della Porta's accounts of other authors' defective recipes were hardly examples of contingent

[57]Bacon (1996, pp. 13–15).
[58]Bacon (1857–1874, Vol. 2). On the role of experiments in *Sylva Sylvarum*, see especially Rusu (2013).
[59]See especially Leong (2018).
[60]Pastorino (2009, pp. 650–653).
[61]Dupré (2017); Leong (2018, p. 97).
[62]See the collection of essays in Leong & Rankin (2017).
[63]Eamon (1994, p. 221).

narratives of experimentation; their main function was to reinforce Della Porta's authority and show his superior understanding of a technique.

Recipe trials were obviously strongly connected to a recipe, as they tested its efficacy or the role of a particular ingredient or procedure. However, in certain cases, they could depart more significantly from it, using the recipe merely as a starting point for further exploration, instead describing new, unplanned occurrences. The "16th-century artisanal and technical manuscript" of an anonymous "author-practitioner" studied by the *Making and Knowing Project* led by Pamela H. Smith provides an example of this further shift.[64] This text included different types of accounts of technical processes, ranging from recipes to first-hand narratives of tests and trials. For instance, as Vera Keller has shown:

> Over the course of several pages, the author-practitioner describes a series of different trials of sands for casting. In one such description, he documents his stages of trial, failure, mental processes, and concludes with a general causal explanation for his eventual success ("For lean sands barely release well and yet they receive metal well," fol. 85r). In marginal notations, he notes ideas for future trials.[65]

In this case, Keller suggested, the author of the manuscript included historical "first-person narrations" of trials, in which the stages of a procedure were re-enacted together with comments and speculations about the experimental process, in a manner that was not dissimilar to that suggested by Francis Bacon's "initiative method." The author-practitioner was likely not writing for a public audience, but merely annotating his own personal thoughts and comments; nevertheless, it is certainly true that the elements of his account would have fit well with the ones that Bacon delineated for his experimental histories.

Alchemical literature can supply further interesting examples. For instance, William Newman has shown how the well-known Prussian alchemist Alexander von Suchten (ca. 1520–1590) used a historical narrative style to present experimental results in his *Tractatus secundus de antimonio vulgari* (1604). In the treatise, while describing his assay of artificial silver, "Suchten is clearly relating a historical event." As Newman observed, "Suchten employs the first person singular, and carefully describes the experimental procedure that he has employed. He is not referring to generalized 'experiences,' but to a specific set of operations carried out in a particular time."[66] It is also interesting to note that Suchten's account described a procedure that did not bear the expected results, and in which alchemical transmutation was in fact disproven.[67] In this respect, it is significant that Suchten's historical narrative concerned an assay trial. Alchemists, goldsmiths, and mint officers routinely made these technical tests and often reported them in written accounts. Their relationship with recipes is interesting: while assay trials followed established and consolidated procedures, their goal was of course that of assessing metallic ores and metals, and not recipes themselves. Accounts of assay trials were inherently descriptions of unique and specific tests and experiments. From this point of view, because of their contingent character, assay reports differed significantly from the instructional, recipe-like descriptions of assaying procedures that could be found in treatises like Agricola's or Biringuccio's.[68]

Finally, accounts of medical trials in natural histories furnish a further important example. Evan Ragland has produced a thorough analysis of these trials in the medical literature of the 16th and early 17th centuries. As Ragland has shown:

> Throughout the sixteenth century, academic physicians frequently made active, first-person tests of things and claims in order to reject, generate, and warrant factual and even theoretical knowledge.

[64]MS. Fr. 640, Bibliothèque nationale de France, Paris, France. See Smith et al. (2020), available online at http://edition640.makingandknowing.org.
[65]Keller (2020).
[66]Newman (1998, pp. 26–30).
[67]For further examples of testing in an alchemical context, see also Ragland (2017, p. 518).
[68]Pastorino (2009).

> These examples do not appear in the margins of medical discourse. On the contrary, they dot standard textbooks and the treatises and lectures of popular physicians across the sixteenth century.[69]

Many of these trials were conventional tests of medical recipes. However, physicians often also made more open experimental tests in the context of natural histories. This is particularly significant in terms of the shift of the natural historical genre to including experimental material. According to Ragland, physicians writing natural histories did not "articulat[e] a vision of making trials with a systematic or philosophical style even close to the sophisticated treatments found in Francis Bacon's works." At the same time, there is no doubt that "taken together, these instances of repeated trial-making form a picture of a learned culture that increasingly depended on the making of first-person, contrived tests of things and claims."[70]

As the previous discussion and examples make clear, there is no doubt that the move beyond canonical recipes was a diffuse phenomenon that happened in diverse contexts and settings during Francis Bacon's time. Recipes were often trialed, and, on occasion, experimenters would provide accounts of these tests. Also, in other circumstances, practitioners would produce more open forms of experimentation, moving away more unequivocally from the recipe format. In crucial occurrences, trials would take center stage and recipes would only have an auxiliary function. This was the case, for instance, in tests in mints or arsenals, which uses a recipe to produce new knowledge about a metal or material. Finally, open forms of trials could dispense with recipes altogether, and describe entirely new experimental settings, inventions, and processes.

In this larger context, the case of Francis Bacon stood out. What truly differentiated his efforts was their programmatic and unambiguously intentional character. Others had started to practice forms of reporting that moved beyond the recipe genre. However, for Bacon, the question of the most fruitful strategies for the communication of knowledge, and experimental knowledge in particular, became foundational. Around these strategies, Bacon built and articulated a coherent and structured research program. The purpose of Baconian natural and experimental histories was nothing less than the "building up of Philosophy."[71] Bacon's aspiration was that the histories would be the cornerstone that would support the "Interpretation of Nature" and the establishment of the true principles of all arts and sciences. Communicated in its active and provisional form, craft knowledge would enter scholarly discourse and be brought to the attention and use of both philosophers and the state. In this respect, it is crucial to remember that Bacon's reform of experimental reporting grew out of his early attempts to systematize the descriptions of new technological inventions in a *Historia mechanica*. In what Bacon thought was a virtuous circle, reform of philosophy would go hand in hand with the revision of the traditional strategies for the production of innovation in early Stuart England, and the development of the new genre would support these more general plans.[72]

7 | BEYOND RECIPES: CONCLUSIONS

The previous discussion has shown that Francis Bacon devised a new epistemic genre of technical and experimental communication. However, how successful were the Baconian natural and experimental histories, beyond the use that Bacon made of them? It is surprising that the charting of their diffusion and influence on experimenters of the 17th and 18th centuries is still largely incomplete.

For instance, the Baconian experimental histories played a significant role for the early members of the Royal Society, but one that is still not widely recognized. In a very influential article, Steven Shapin strongly downplayed the notion that Bacon had much to do with Robert Boyle's formulations of experimental accounts:

[69]Ragland (2017, p. 525).
[70]Ragland (2017, p. 527). With a few exceptions, the role of the medical tradition in the development of Francis Bacon's ideas has been largely overlooked. On the variety of historical accounts in different types of medical histories, see Pomata (2005).
[71]Bacon (2007, p. 2).
[72]On this issue, see Pastorino (2017, especially pp. 765–767).

> Although Boyle's inspiration may, plausibly, have been Baconian, the 'influence' of Bacon is sometimes much exaggerated …. It is useful to remember that it was Boyle, not Bacon, who actually developed the literary forms of experimental communication; it is hard to imagine two more different forms than Bacon's aphorisms and Boyle's experimental narratives.[73]

Shapin focused his attention on Bacon's aphorisms of the *Novum Organum* and Boyle's experimental essays, and there is no doubt that these two forms were quite unrelated epistemic genres. At the same time, if we shift attention from aphorisms to experimental histories, the picture changes completely. For one thing, historical accounts of experimentation, together with personal interpretations and speculations, were integral elements of Bacon's new genre, and certainly anticipated features of Boyle's essays.[74] Moreover, as Michael Hunter and Peter Anstey have shown, if Boyle's early works had only a little explicit debt to Bacon, this was not the case for writings developed from around the mid-1660s onward. Around that time, the tenets of Baconian natural histories became the "centrepiece of Boyle's methodology in natural philosophy, informing both his practice and his published output," including straight experimental histories in a Baconian vein, like the *New Experiments and Observations Touching Cold* (1665), the *Memoirs for the Natural History of Human Blood* (1684) and the *Short Memoirs for the Natural Experimental History of Mineral Waters* (1685).[75] Around the same period, Robert Hooke composed detailed plans for the preparation of Baconian natural and experimental histories—the "Lectures of Things Requisite to a Natural History" and the posthumous "General Scheme, or Idea of the Present State of Natural Philosophy" (1705). Additionally, Peter Anstey has convincingly argued that "the construction of natural histories, as advocated by Francis Bacon, played a central role in John Locke's conception of method in natural philosophy."[76] Finally, the program for a History of Trades championed by the early Royal Society had a well-recognized connection with the genre of Baconian histories.[77] It is clear, then, that the specific influence of this genre on the English natural philosophers of the second half of the 17th century was substantial.

Beyond 17th-century England, Ursula Klein and Wolfgang Lefèvre have delineated a tradition of chemical experimental histories in continental Europe during the 18th century.[78] They rightly emphasized the role played by Herman Boerhaave and his adoption of the style of Bacon's experimental histories. They also suggested the existence of a marked distinction between 18th-century experimental histories and experimental philosophies. Overall, they deemphasized the philosophical character of such histories.[79] However, this was not the case for Bacon and 17th-century authors like Boyle and Hooke, who followed a middle path: for instance, Boyle defined the experimental reports in his *Experiments and Considerations Touching Colours* (1664) as follows: "finding my self as unfit to speculate, as unwilling to be altogether idle, I chose this diversion, as a kind of Mean betwixt the one and the other."[80]

More work remains to be done to delineate the precise shape that the genre of the Baconian experimental histories took through various later developments. At the same time, it was Francis Bacon who outlined its original defining features. These characteristics, and the provisional, tentative character of Bacon's experimental accounts, were entirely consistent with his tenets regarding the communication and transmission of knowledge. The contrast and differentiation between knowledge "in use" and "in progression," and between a "magistral" method and a method of "probation," captured well the distinction between the tradition of early modern books of secrets and technical treatises, on the one hand, and Bacon's novel attempts at a reform of how experimental knowledge should be presented, on the other. Bacon's accounts of experiments developed into complex entities; they shared some of their

[73]Shapin (1984, p. 516, n. 29). However, Shapin did suggest a possible connection between "Boyle's justification for circumstantial reporting and Bacon's argument in favour of 'initiative' (as opposed to 'magistral') methods of communication in science." Shapin (1984, p. 515).
[74]Bacon (2007, pp. 13–17).
[75]Anstey & Hunter (2008, p. 84).
[76]Anstey & Hunter (2008); Hunter (2007); Anstey (2002; 2014).
[77]Hunter (1981); Ochs (1985).
[78]Klein & Lefèvre (2007, Ch. 2).
[79]Klein & Lefèvre (2007, pp. 25–26).
[80]Boyle (1664, p. 2).

characteristics with the recipe format, but at the same time deviated significantly from it. Even though his initial model was the recipe, Bacon immediately subjected its template to substantial stresses and modifications, crucially altering its structure. Most of all, if recipes described established technical processes, rhetorically expressed in a canonical form, Bacon's accounts were constructed to depict "event experiments," that is to say individual and historically contingent trials of unexplored phenomena.[81] These accounts purposefully delineated imperfect experimental attempts, never entirely fixed and established in an exemplary fashion. The difference with the recipe genre was sharp. Paradoxically, Bacon added flaws, contingency, and uncertainty to it. In the template for experimental reporting of his experimental histories, imperfection became a valued epistemic feature.

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ORCID

Cesare Pastorino https://orcid.org/0000-0001-9135-8291

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[81]On "event experiments" in Bacon, see also Pastorino (2011, pp. 565–567).

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